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Quantum Interference Control of Currents in Bi_2Se_3 Topological Insulators[1] DEREK BAS, West Virginia University, KEVIN VARGAS, University of Puerto Rico at Mayagüez, SERCAN BABAKIRAY, TRENT JOHNSON, YURI GLINKA, MIKEL HOLCOMB, DAVID LEDERMAN, ALAN BRISTOW, West Virginia University — Quantum interference control of bulk and surface currents are investigated in Bi_2Se_3 films ranging from 6 to 40 quintuple layers in thickness. The samples are grown with a two-step method on sapphire substrates and protected with an MgF_2 capping layer that prevents oxidation. Co-polarized harmonically related pulses excite a population of carriers through interference of single- and two-photon absorption pathways. Dependences of the relative phase between the two pulses and intensity of each pulse show the correct signatures confirming the third-order nonlinear optical process. We observe an increase in the strength of the injected currents with decreasing thickness and a peak at 10 quintuple layers. It is believed that the peak coincides with the onset of hybridization of the Dirac cone on opposite surfaces of the sample. The increase in signal strength is related to an increase in the expected spin-polarized surface currents, which begin to dominate over the bulk pure charge currents.

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